SOLAS: Connecting Sea and Sky

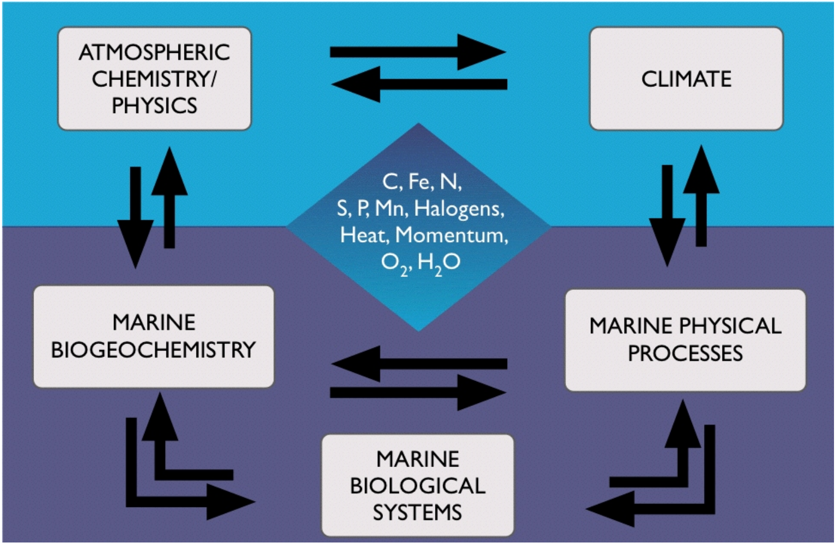
surface ocean solas lower atmosphere study

- The Surface Ocean - Lower Atmosphere Study (SOLAS) is a multidisciplinary and global-scale research programme.
- SOLAS integrates the efforts of marine biogeochemists, physical oceanographers, atmospheric chemists, meteorologists and climatologists, covering scales from the microbial to global
- SOLAS Goal:

  To achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere, and how this coupled system affects and is affected by climate and environmental change

- SOLAS is Sponsored by SCOR, IGBP, CACGP and WCRP
- IGBP Core Project
- Part of the Earth System Science Partnership

SOLAS Science



SOLAS: Mid-Term Strategies

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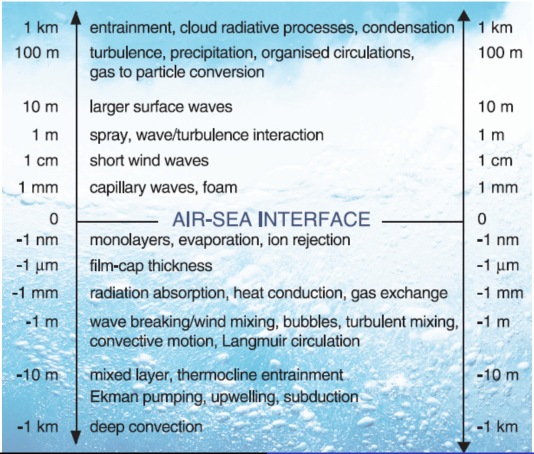
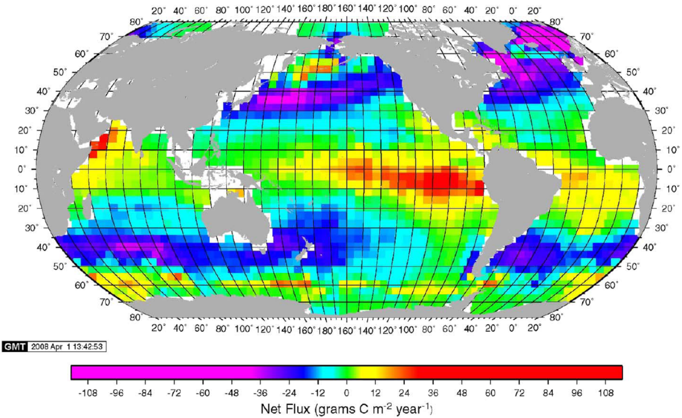
- Sea-ice biogeochemistry and interactions with the atmosphere
- Ocean-derived aerosols: production, evolution and impacts
- Atmospheric control of nutrient cycling and production in the surface ocean
- Ship plumes: impacts on atmospheric chemistry, climate and nutrient supply to the oceans
- Air-sea gas fluxes at Eastern boundary upwelling and Oxygen Minimum Zone (OMZ) systems
- SOLAS Observatory and MOIN: the Minimalist OceanSITES Interdisciplinary Network

- A distinctive feature of the ocean surface and surrounding air is the progressive change in scale and progressively greater interdependence of different processes as the interface is approached



Quantifying CO_2 Uptake by the Ocean



Air-sea CO_2 flux F:

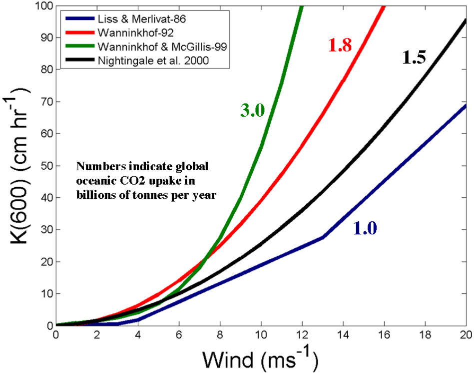
$$F = ks\Delta pCO_2$$

k = transfer velocity
s = solubility
$\Delta p\mathrm{CO}_2$ = partial pressure difference between ocean and atmosphere

- Current estimates is that the oceanic uptake flux including anthropogenic CO_2 is 2.0 ± 1.0 Pg-C yr^{-1}
- The goal is to resolve air sea CO_2 fluxes to 0.2 Pg-C yr^{-1}

Parameterising Air-Sea CO_2 Fluxes

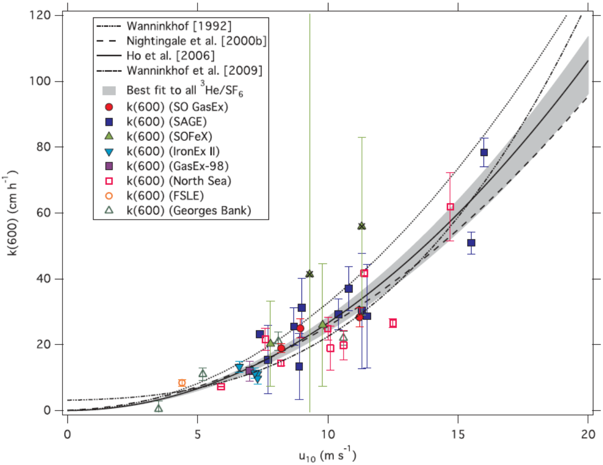
$$F = k \cdot s \cdot \Delta pCO_2$$



From Feely et al. (2001)

- Transfer velocity k is not constant, but varies with wind speed, sea state, turbulence in the surface ocean, wave breaking, whitecapping, and the presence or otherwise of surfactants and rain
- Transfer velocity k is usually parameterized with wind speed e.g. $k \propto u^a Sc^{-b}$
- Parameterisations of k differ by about 50% for winds of 7 $\mathrm{ms}^{-1}$and by 100% at 15 ms^{-1}
- Direct measurements of fluxes will lead to improved models

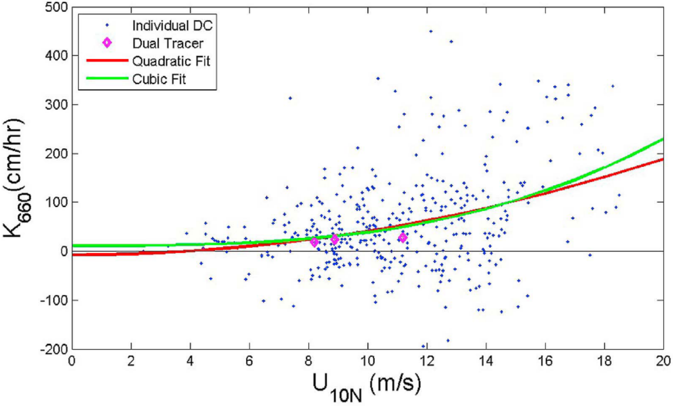
Dual Tracer Transfer Velocity



From Ho et al. (2011)

- Dual Tracer method provides well-constrained transfer velocity data
- Other direct method for determining k is eddy covariance

Eddy Covariance Transfer Velocity



From Edson et al. (2011)

- Eddy covariance k values have many more data points but much higher scatter